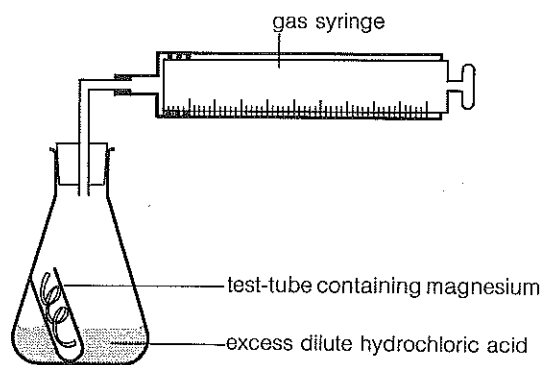


## Section 9c. Rates of reactions

- 1 The rate of the reaction between magnesium and dilute hydrochloric acid could be measured using this apparatus:



- a What is the purpose of:
- the test-tube?
  - the gas syringe?
- b How would you get the reaction to start?
- 2 Some magnesium and an *excess* of dilute hydrochloric acid were reacted together. The volume of hydrogen produced was recorded every minute, as shown in the table:

Time/min	0	1	2	3	4	5	6	7
Volume of hydrogen/cm <sup>3</sup>	0	14	23	31	38	40	40	40

- a What does an *excess* of acid mean?
- b Plot a graph of the results, labelling the axes as on page 121.
- c How much hydrogen was produced in:
- the first minute?
  - the second minute?
  - the third minute?
  - the fourth minute?
  - the fifth minute?
- d What is the *rate of the reaction* (cm<sup>3</sup> of hydrogen per minute) during each minute?
- e What is the total volume of hydrogen produced in the reaction?
- f How many minutes pass before the reaction finishes?
- g What is the *average rate* of the reaction?
- h A similar reaction had a rate of 15 cm<sup>3</sup> of hydrogen in the first minute. Is this a slower or faster reaction than the one above?
- i How could you make the above reaction go slower, while still using the same quantities of metal and acid?
- j How could you make it go faster?

- 3 For this question you will need the graph you drew for question 2.

The experiment with magnesium and an excess of dilute hydrochloric acid was repeated. This time a different concentration of hydrochloric acid was used. The results were:

Time/min	0	1	2	3	4	5	6
Volume of hydrogen/cm <sup>3</sup>	0	22	34	39	40	40	40

- a Plot these results on the graph you drew for question 2.
- b Which reaction was faster? How can you tell?
- c In which experiment was the acid more concentrated? Give a reason for your answer.
- d The same volume of hydrogen was produced in each experiment. What does that tell you about the mass of magnesium used?
- 4 Name three factors that affect the rate of a reaction, and describe the effect of changing each factor.
- 5 Suggest a reason for each of the following observations:
- Magnesium powder reacts faster than magnesium ribbon, with dilute sulphuric acid.
  - Hydrogen peroxide decomposes much faster if you add a piece of raw liver. But boiled liver has no effect on it.
  - The reaction between manganese carbonate and dilute hydrochloric acid speeds up when some concentrated hydrochloric acid is added.
  - Zinc powder burns much more vigorously in oxygen than zinc foil does.
  - The reaction between sodium thiosulphate and hydrochloric acid takes a very long time if carried out in an ice bath.
  - Zinc and dilute sulphuric acid react much more quickly when a few drops of copper(II) sulphate solution are added.
  - Drenching with water prevents too much damage from spilt acid.
  - A car's exhaust pipe will rust faster if the car is used a lot.
  - In fireworks, powdered magnesium is used rather than magnesium ribbon.
  - In this country, dead animals decay quite quickly. But in Siberia, bodies of mammoths that died 30 000 years ago have been found fully preserved in ice.
  - The more sweet things you eat, the faster your teeth decay.
  - Food cooks much faster in a pressure cooker than in an ordinary saucepan.
  - A concentrated solution of bleach is used for removing stains.